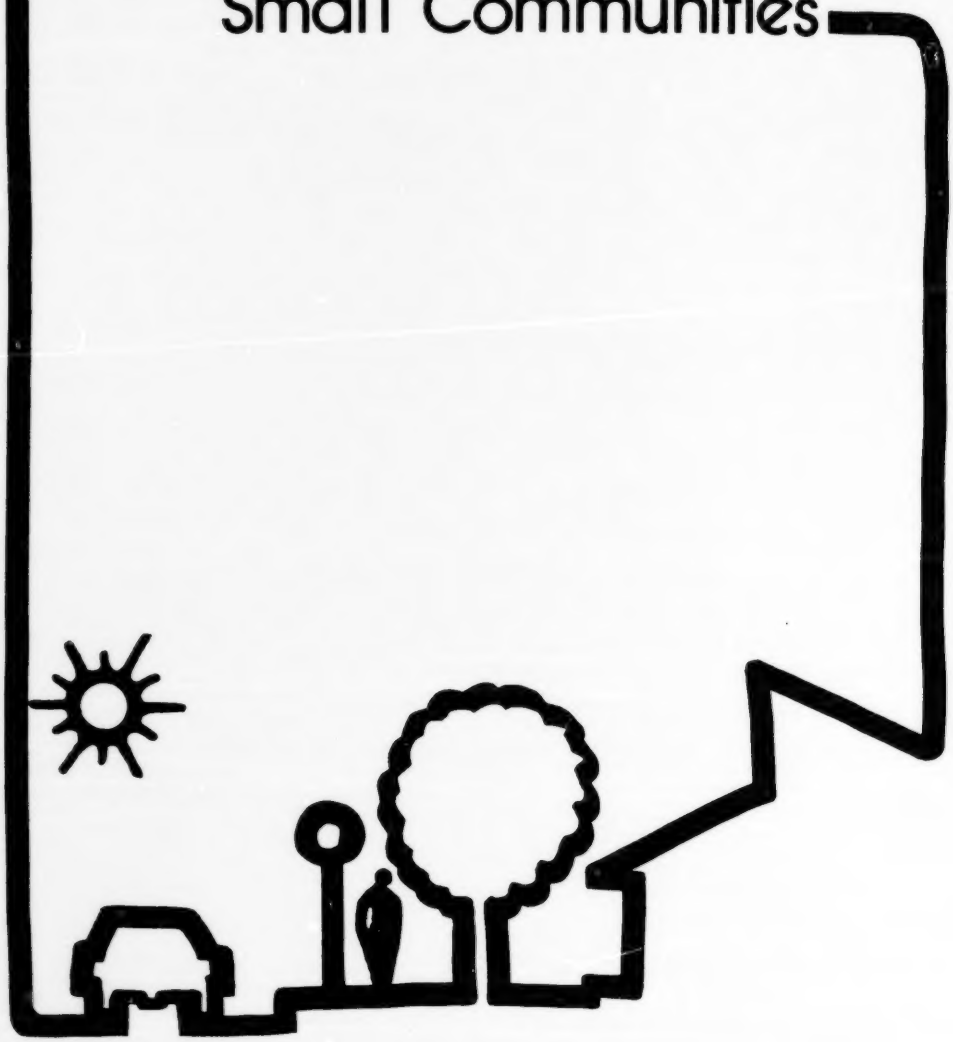
Residential Site Design Alternatives in Small Communities



September 1981

Ontario

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Residential Site Design Alternatives in Small Communities

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September 1981

Available from:
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Preface

This report is a supplement to "A Guide to Residential Planning and Design in Small Communities" published by the Ministry of Housing in March 1980.

The four alternative plans discussed in the report cover a range of development possibilities in a low-density subdivision in terms of layout, number of units, costs of underground services and road construction, and use of solar energy. The most efficient subdivision in terms of per dwelling unit cost is the one designed using the Ministry of Housing's "Urban Development Standards" which were published in March 1976. However, it is shown that an energy-efficient subdivision can also be designed using these standards with only a modest increase in the per dwelling unit cost. The traditional plan of subdivision is the most costly to build and is the least energy-efficient.

The subdivisions discussed in this report are only a small selection of the number of alternatives available to the site designer. The important principle is that each option should be carefully considered from the point of view of economy, aesthetics, and the impacts of environmental factors and energy conservation requirements.

It is hoped that this report will further assist those who design, review or approve new residential development in small communities and who have little or no access to professional advice.

G. Keith Bain,
Director,
Local Planning Policy Branch

September 1981

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1. Introduction

Purpose

This report is a supplement to "A Guide to Residential Planning and Design in Small Communities" published by the Ministry of Housing in March 1980. It addresses itself to Ontario municipalities with a population of 25,000 or less, and to housing projects within the density range of 15-25 units per hectare (6-10 units per acre).

The report illustrates four approaches to the design of a low density housing subdivision. The subdivisions are examined in relation to:

- Design problems.
- The use of different lot size, road allowance and water and sewer servicing standards.
- The conservation of space heating energy.
- The opportunities for landscaping.

The total subdivision would be developed in phases in a small community. In reality, each phase of development is determined by many factors but, for the purposes of this report, phasing has been related only to servicing area.

The site has an area of 31.5 ha (78.73 acres). The subdivisions each contain approximately 60 per cent detached, 30 per cent semi-detached, and 10 per cent street townhouse units.

Gross residential density (i.e. neighbourhood or site density) is used. It includes housing sites, local residential streets, collector roads, and the park and open space system.

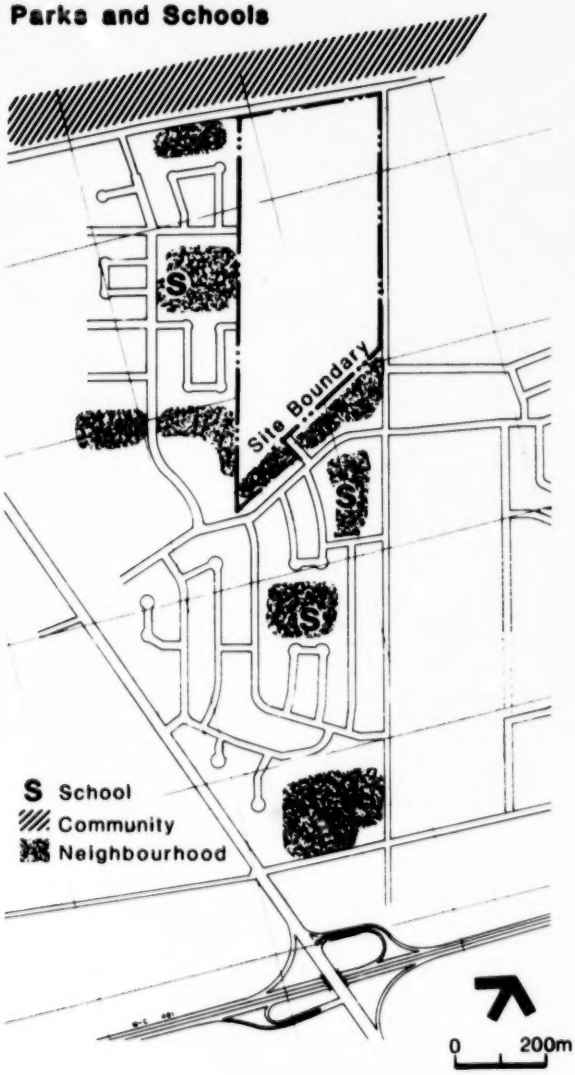
Site Characteristics

Location

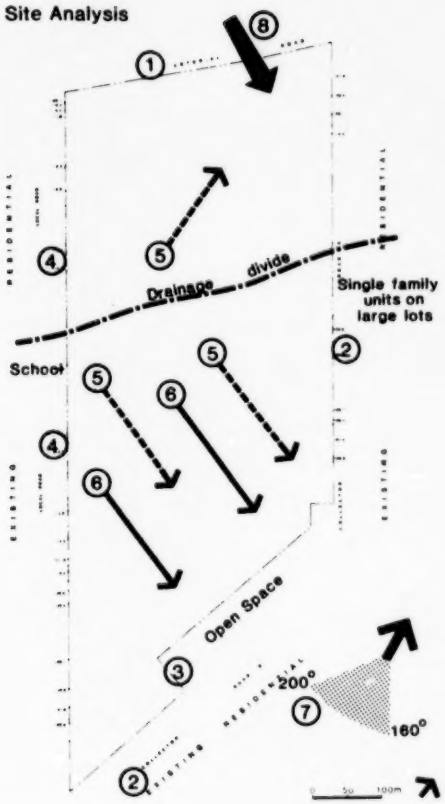
The site chosen is within a town. Road connections are excellent.

Major Roads

Parks and Schools



Because parks and a school are nearby, it is only necessary to provide a small park within the site.



Site Analysis

Site Access:

1. Existing limited access road requiring reversed frontage lots.*
2. Existing major collector roads.
3. Only one access point available to collector road.
4. Access required for existing development.

Drainage and Topography:

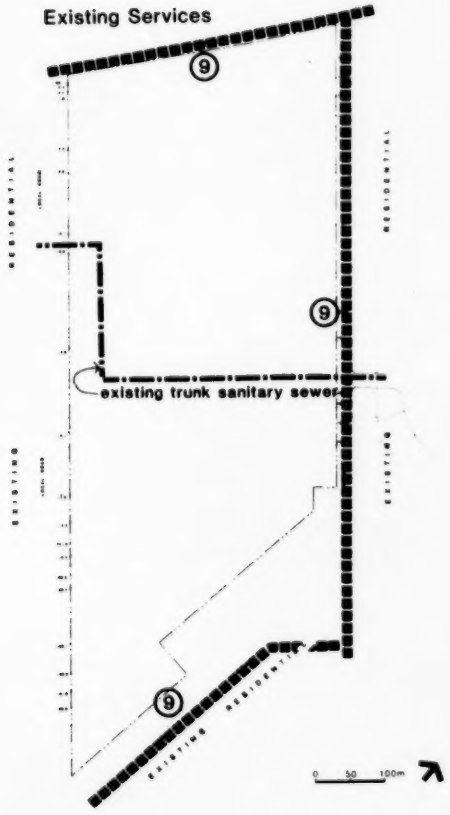
5. Natural drainage.
6. Moderate (2-3.5%) easterly slope.

Climate:

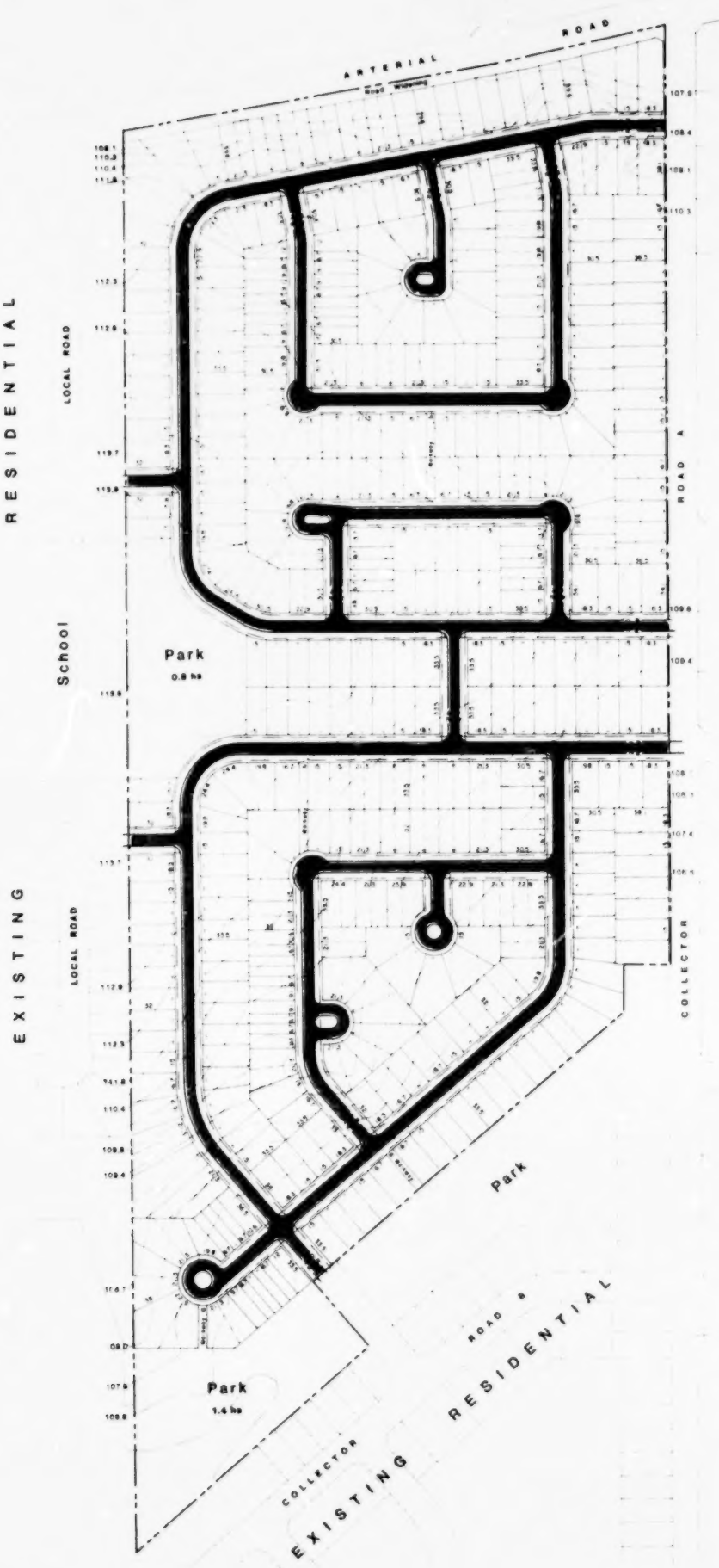
7. Range of effective solar orientation for passive solar heating of buildings.
8. Prevailing wind direction.

Utility Services:

9. Watermain, sanitary and storm sewers available.



There are other methods that can be used, such as fronting the houses onto a service road parallel to the limited access road, building design, and small open-ended cul-de-sacs at right angles to the major road. For a discussion of other techniques, see the Ministry of Housing publication "Land Use Planning for Noise Control in Residential Communities". August 1980.



Land use	Plan 1	
Frontage/unit	# units	%
Detached		
18.3m 60'	30	6.6
15m 50'	236	52.4
12m 40'		
10.7m 35'		
9.2m 30'		
Sub-total	269	59.0
Semi-detached		
10.7m 35'	116	25.7
9.2m 30'	18	4.3
8.1m 26.5'		
Sub-total	134	30.0
Townhouses		
6.4m 21'		
6.7m 22'	51	11.0
Sub-total	51	11.0
Total	454	100
Gross density	5.7 u/ac 14.2 u/ha.	

Plan 1

0 50 100 m

2. Plan Analysis

Plan 1

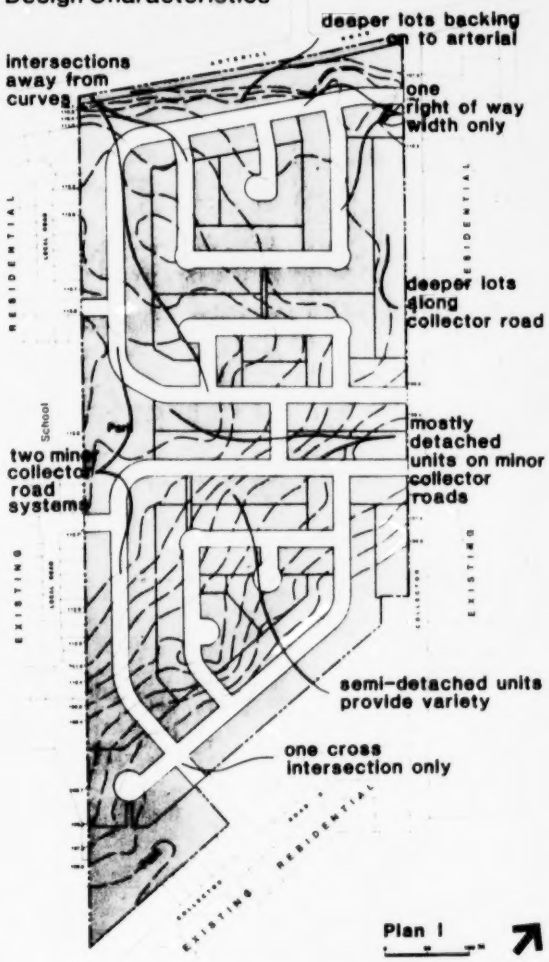
Design Objective

To design a subdivision to traditional standards.

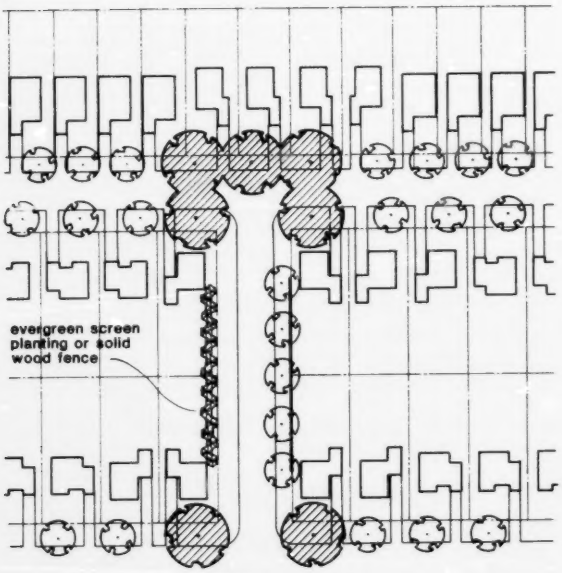
Design Characteristics

- The street pattern is traditional and is based on one type of road (width of 20m/66 ft.).
- Two minor collector streets are provided, one for each phase of development, so that traffic through the major part of the subdivision is discouraged.
- Road intersections are kept away from curves.
- Crossroads are virtually eliminated.
- Lots are reversed and deeper along the arterial road to minimize noise and fume nuisance, and to avoid interference with the arterial traffic flow which would be caused by cars exiting from the individual houses.
- Lots are deeper along the collector road in order to provide for an additional setback of the houses away from the traffic noise.
- Mostly detached units are located on the collector and minor collector roads to minimize the number of driveways.
- Larger lots are located at street intersections to provide somewhat better traffic visibility and homeowner privacy.
- Semi-detached lots provide a varied streetscape on the longer streets and a linkage between row and detached housing.
- The park is provided as an extension of the existing school site.

Design Characteristics



- In this traditional subdivision, the deeper and wider lots provide the opportunity for a variety of set-backs. When used in conjunction with boulevard trees planted in groups to form a series of open places within a street, the set-backs allow a high degree of variety in a street scene.



Creation of a focal point at the end of streets by planting trees with special visual impact.

Subdivision Analysis

	Plan 1
Gross area	31.8ha. 78.7ac.
Road length 21.5m 70' R.O.W. 20m 66' 17m 56' 15m 50'	 320m 1050' 3901m 12800'
Total road length	4221m 13850'
Area of roads	8.5ha. 21.10ac.
Road area as % of total area	26.81
Saleable frontage	5934m 19470'
Road length/ Saleable frontage ratio	1:1.4

- The density of 14.2 units per hectare (5.7 units per acre) is normal for a traditional subdivision.
- The road area (27 per cent of the total) is relatively high compared to the other plans. Some land is lost that could be used for house building.
- The saleable frontage ratio of 1.4:1 is low. In a street with houses on both sides, the saleable frontage is obviously 2:1. The loss of .6:1 saleable frontage is high compared to the other plans.

Underground Services and Road Construction*

	Plan 1
Sanitary sewers	$474,850.00
Storm sewers	$541,745.00
Watermain	$375,500.00
Roads	$1,253,683.45
Provisional items	$16,875.03
Contingency	$79,881.41
Sub-total	$2,742,595.89
Engineering 12% of sub-total	$329,111.38
Total	$3,071,706.27

#.units	454
Cost/unit	$6,766.80

- The use of the traditional storm sewer system and 20m (66 ft.) road right-of-way is expensive.

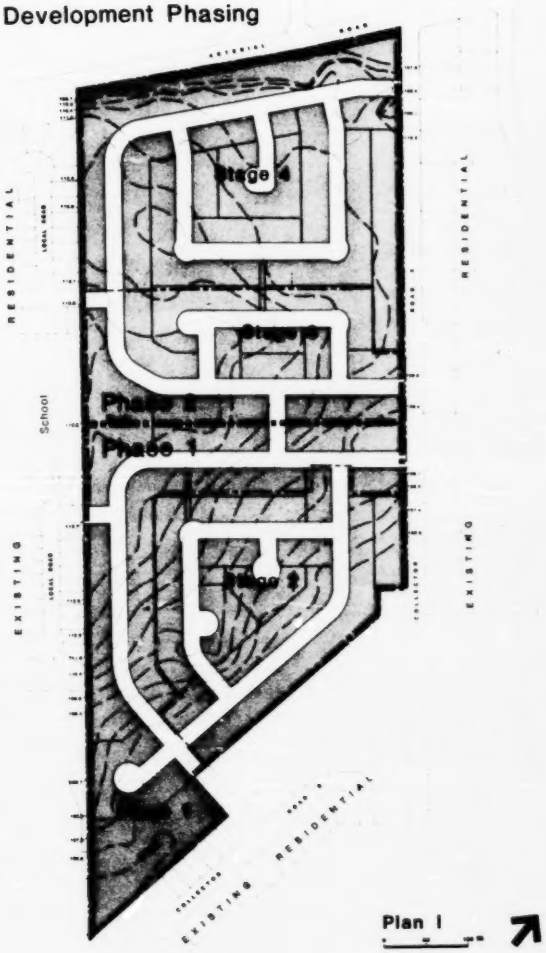
**Detailed cost estimates for each plan are available upon request from the Local Planning Policy Branch.*

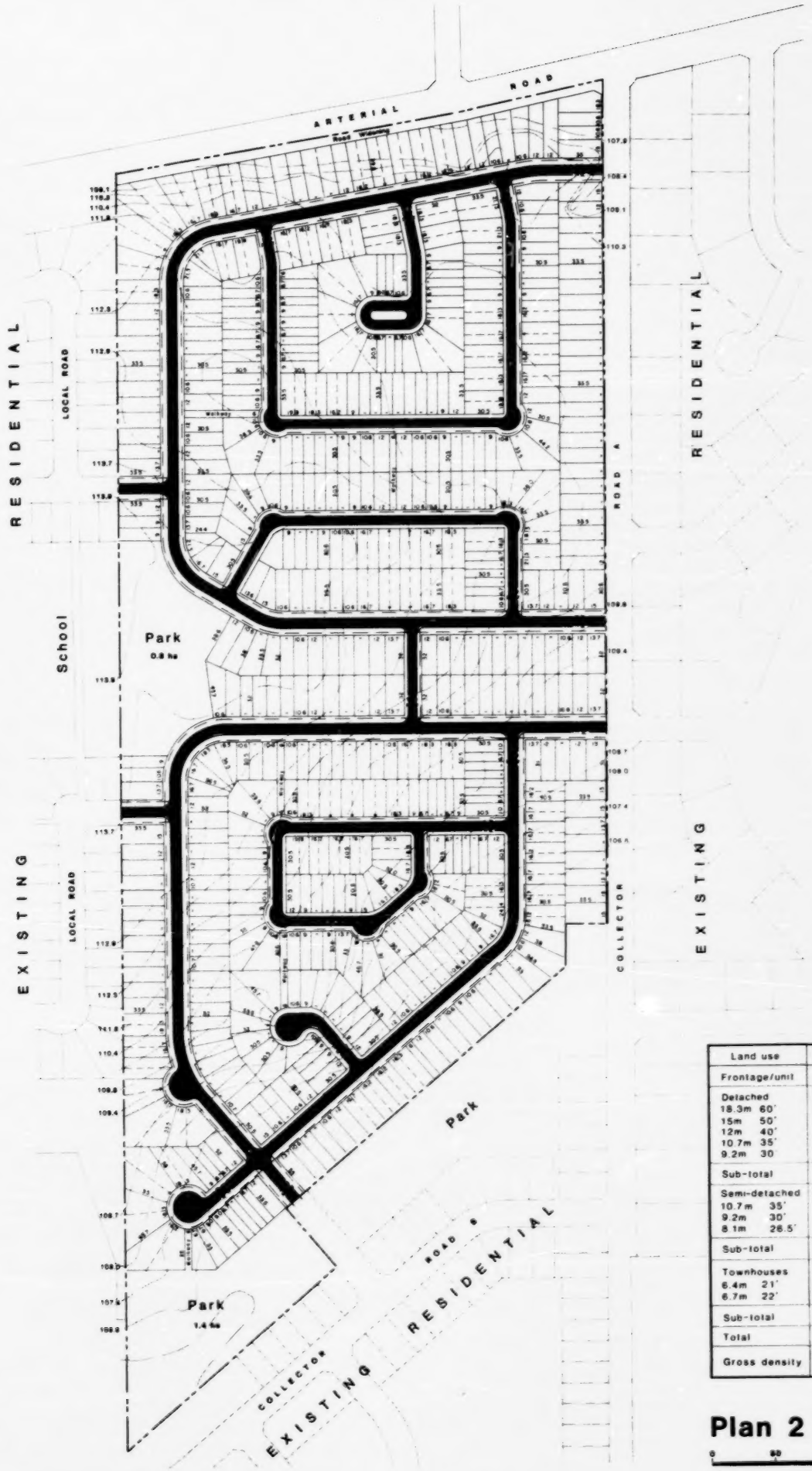
Phasing

- Phase 1 is developed mainly along both sides of a new road which incorporates the existing sanitary trunk across the site. In this way, an existing service line produces the most frontage.
- Phase 2 utilizes the remaining part of the existing sanitary trunk across the site.

Each of these phases can be broken down into two stages, each stage being realistic for small towns (varying from approximately 6 to 10 hectares - 85 to 166 units).

Development Phasing





Land use	Plan 2	
Frontage/unit	# units	%
Detached		
18.3m 60'		
15m 50'	34	5.3
12m 40'	125	19.5
10.7m 35'	116	18.0
9.2m 30	103	16.1
Sub-total	378	58.9
Semi-detached		
10.7m 35'	10	1.5
9.2m 30'	72	11.4
8.1m 26.5'	106	16.6
Sub-total	188	29.5
Townhouses		
6.4m 21'		
6.7m 22'	74	11.6
Sub-total	74	11.6
Total	640	100
Gross density	8.1 u/ac. 20.1 u/ha.	

Plan 2

0 50 100 m

Plan 2

Design Objective

To redesign Plan 1 using substantially the same road pattern and the "Urban Development Standards" published by the Ministry of Housing in 1976, which suggested revisions in site engineering, street width and lot size to reduce development costs.

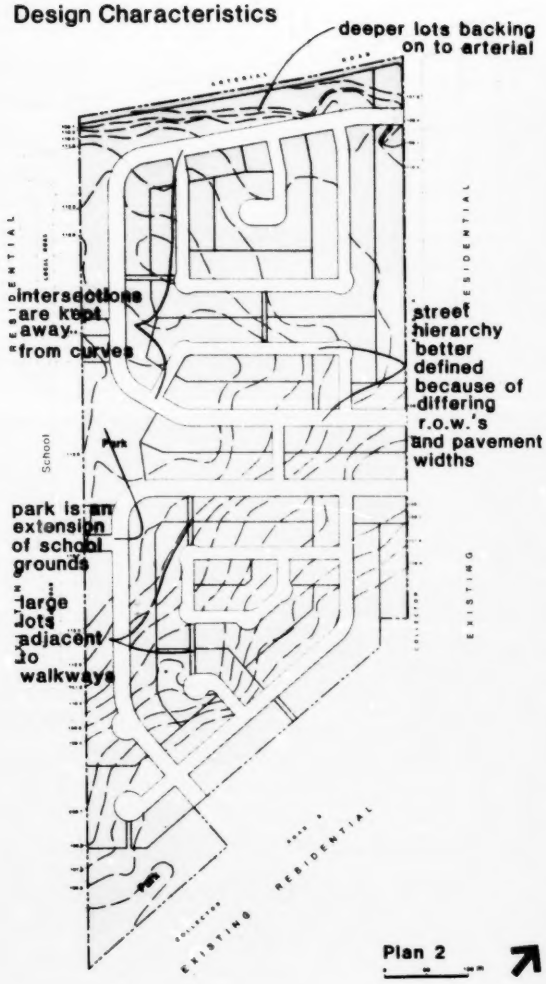
Design Characteristics

- The design is based on the following standards for lot size and road width:

Single family	— 9x 30m (30 x 100 ft.)
Semi-detached	— 7.9 x 30m (26.5 x 100 ft.)
Town houses	— 6.6 x 30m (22 x 100 ft.)
Local roads	— 15m R.O.W. (50 ft.)
	— 17m R.O.W. (56 ft.)
	— 7.8m (26 ft.) pavement with sidewalk on one side only.
Minor collector	— 20m R.O.W. (66 ft.)
	— 8.4m (28 ft.) pavement with sidewalks on both sides

- The internal road pattern is adjusted because of the decrease in the overall width of the blocks.
- The functional hierarchy of the roads is better defined with the use of a variety of street right-of-ways.
- The length of roads is increased from Plan 1 because of the reduced road widths and lot depths.
- Care is again taken to avoid road intersections near curves.
- The detached unit lots of 9 metres in width (30 feet) could be used for zero lot-line housing.
- The park is provided as an extension of the existing school site.

Design Characteristics

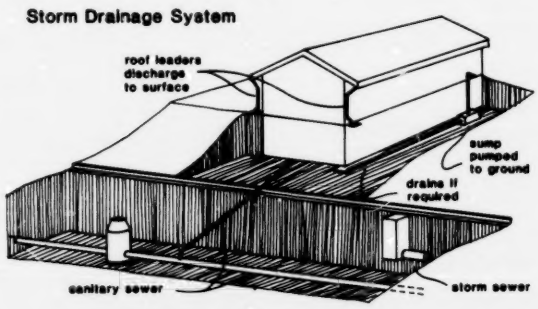

deeper lots backing on to arterial
intersections are kept away from curves
street hierarchy better defined because of differing r.o.w.'s and pavement widths
park is an extension of school grounds
large lots adjacent to walkways
School
Park
EXISTING RESIDENTIAL
Plan 2

Subdivision Analysis

	Plan 2
Gross area	31.8ha. 78.7ac.
Road length 21.5m 70′ R.O.W. 20m 66′ 17m 56′ 15m 50′	 320m 1050′ 1714.5m 5625′ 495m 1625′ 1722m 5650′
Total road length	4259.5m 13975′
Area of roads	7.6ha. 18.81ac.
Road area as % of total area	23.90
Saleable frontage ratio	6233m 20450′
Road length/ Saleable frontage	1:1.46

- The density of 20.2 units per hectare (8.1 units per acre) is an improvement over Plan 1, largely because of the altered lot and road right-of-way standards.
- The road area (24 per cent of the total) is lower than Plan 1 because of the standards and variety of road widths employed.
- The saleable frontage ratio of 1.46:1 is still far from the ideal of 1.6:1 for a low density subdivision.

Underground Services and Road Construction



- The standards include no direct discharge of roof run-off to storm sewers.
- The cost of the storm sewer system is reduced by almost half over that required for Plan 1.
- The widths and variety of roads employed result in a lower cost per unit than Plan 1.

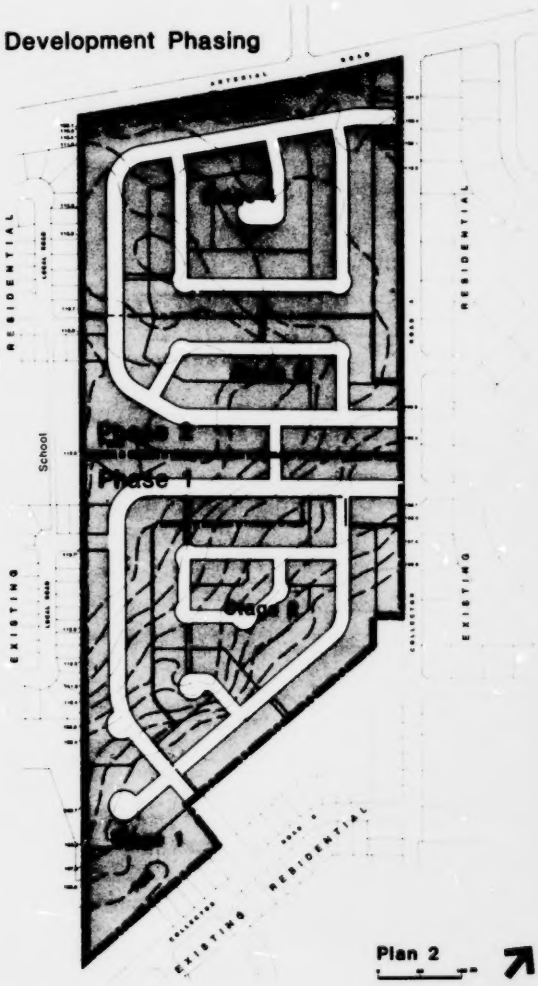
	Plan 2
Sanitary sewers	$537,600.00
Storm sewers	$290,115.00
Watermain	$389,590.00
Roads	$1,135,432.00
Provisional items	$15,122.42
Contingency	$71,035.00
Sub-total	$2,438,896.07
Engineering 12% of sub-total	$292,667.53
Total	$2,731,563.60

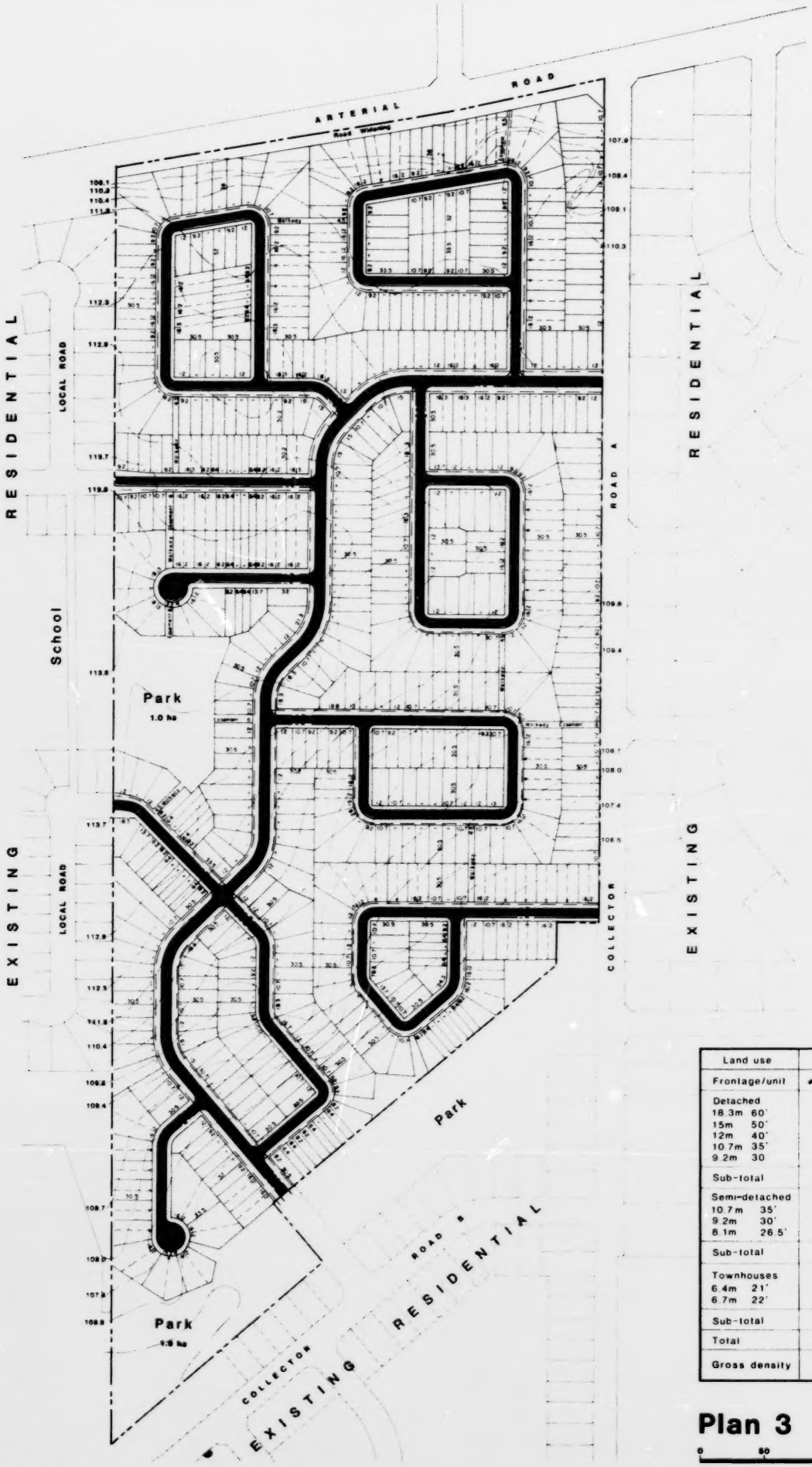
#.units	640
Cost/unit	$4,268.06

Phasing

- The procedure for phase selection and priority is the same as for Plan 1. The stages still range from approximately 6 to 10 hectares, but because of the increased density, the number of units for each phase is between 113 and 238.

Development Phasing





Land use	Plan 3	
Frontage/unit	# units	%
Detached		
18.3m 60'		
15m 50'		
12m 40'	123	18.4
10.7m 35'	161	24.0
9.2m 30	124	18.5
Sub-total	408	60.9
Semi-detached		
10.7m 35'		
9.2m 30'		
8.1m 26.5'	194	29.0
Sub-total	194	29.0
Townhouses		
6.4m 21'	70	10.1
6.7m 22'		
Sub-total	70	10.1
Total	672	100
Gross density	8.5 u/ac. 21.1 u/ha.	

Plan 3

0 50 100 m

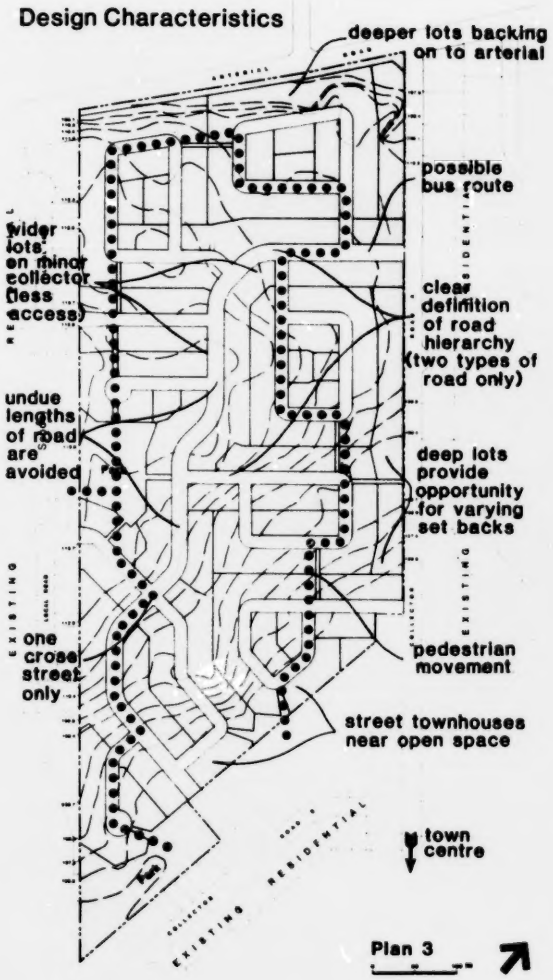
Plan 3

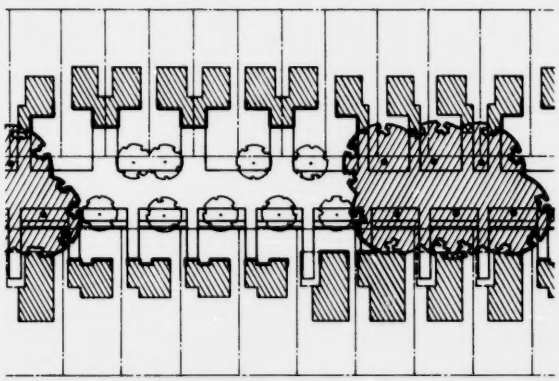
Design Objective

To design a subdivision using the "Urban Development Standards" published by the Ministry of Housing, that is not a variant of a traditional plan.

Design Characteristics

- The street pattern is simple with a clearly defined road hierarchy.
- A greater sense of privacy and variety is created by avoiding long, straight roads.
- The minor collector (the main internal road) provides a route for public transit.
- There is only one cross street.
- A continuous pedestrain walkway system is provided to link all areas of the site with the parks and schools.
- The larger detached lots are located on the collector and minor collector roads to minimize the number of driveways.
- Lots are reversed and deeper (38 m/126 ft.) along the arterial road to minimize noise and fume nuisance.
- The smaller lots and higher density of this plan offer better landscaping opportunities.


Design Characteristics
deeper lots backing on to arterial
possible bus route
wider lots on minor collector (less access)
clear definition of road hierarchy (two types of road only)
undue lengths of road are avoided
deep lots provide opportunity for varying set backs
one cross street only
pedestrian movement
street townhouses near open space
town centre
Plan 3



Creation of street spaces. Identify by arranging trees according to size, type and spacing.

Subdivision Analysis

	Plan 3
Gross area	31.8ha. 78.7ac.
Road length 21.5m 70' R.O.W. 20m 66' 17m 56' 15m 50'	 320m 1050' 899m 2950' 2819m 9250'
Total road length	4046m 13275'
Area of roads	6.7ha 16.8ac.
Road area as % of total area	21.34
Saleable frontage	6530m 21425'
Road length/ Saleable frontage ratio	1:1.61

- The density of 21.2 units per hectare (8.5 units per acre) is an improvement over Plan 2 because of the redesigned road layout.
- The saleable frontage ratio of 1.6:1 is ideal for a low density subdivision.

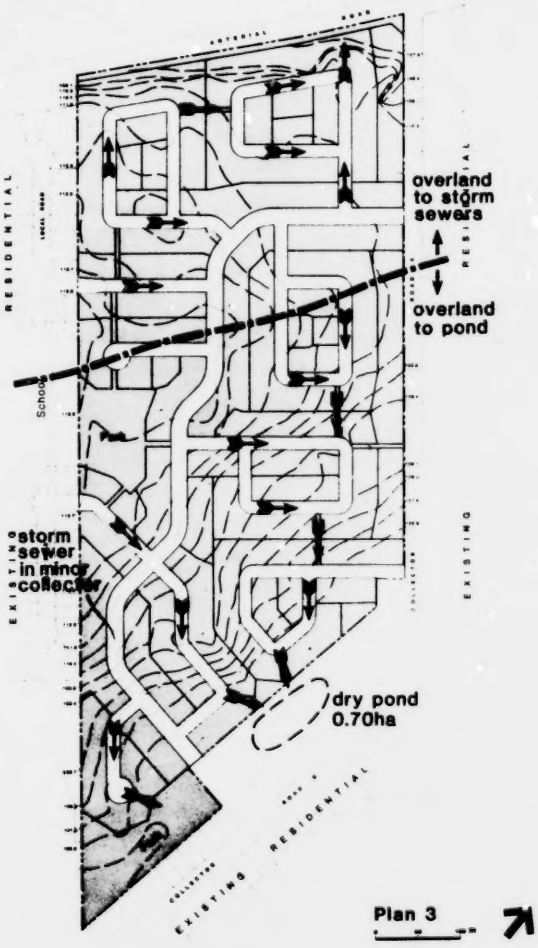
Underground Services and Road Construction

	Plan 3
Sanitary sewers	$577,980.00
Storm sewers	$96,660.00
Watermain	$397,925.00
Roads	$1,043,984.00
Provisional items	$13,705.25
Contingency	$63,907.63
Sub-total	$2,194,162.00
Engineering 12% of sub-total	$263,299.00
Total	$2,457,461.48

#.units	672
Cost/unit	$3,656.93

- As suggested by the Ministry of Housing's "Urban Development Standards", connections between houses and storm sewers are eliminated in favour of a natural run-off assisted by better grading of lots and streets.
- This plan uses overland run-off to the storm sewer system and a "dry" pond in the park.
- The cost of the storm sewer is approximately 80 percent less than the traditional storm system used in Plan 1.

Drainage

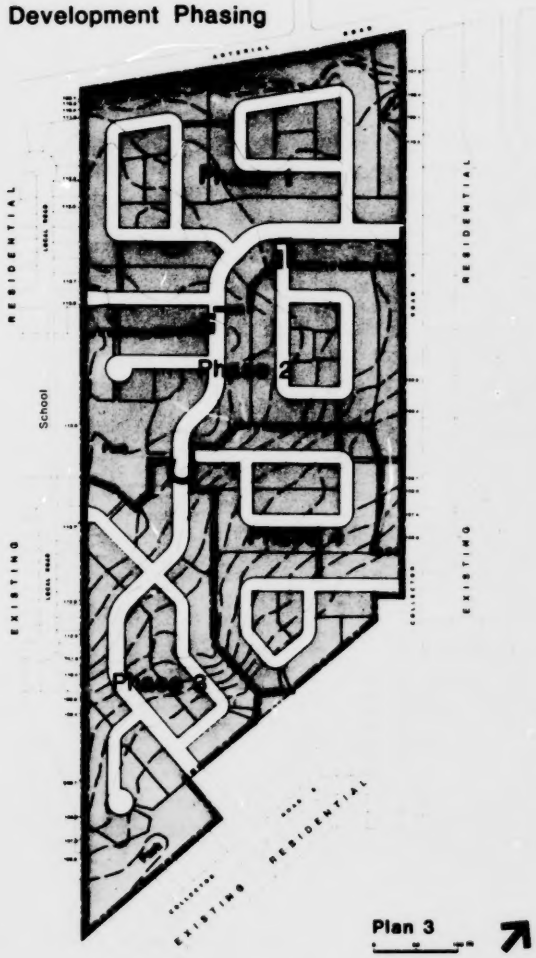


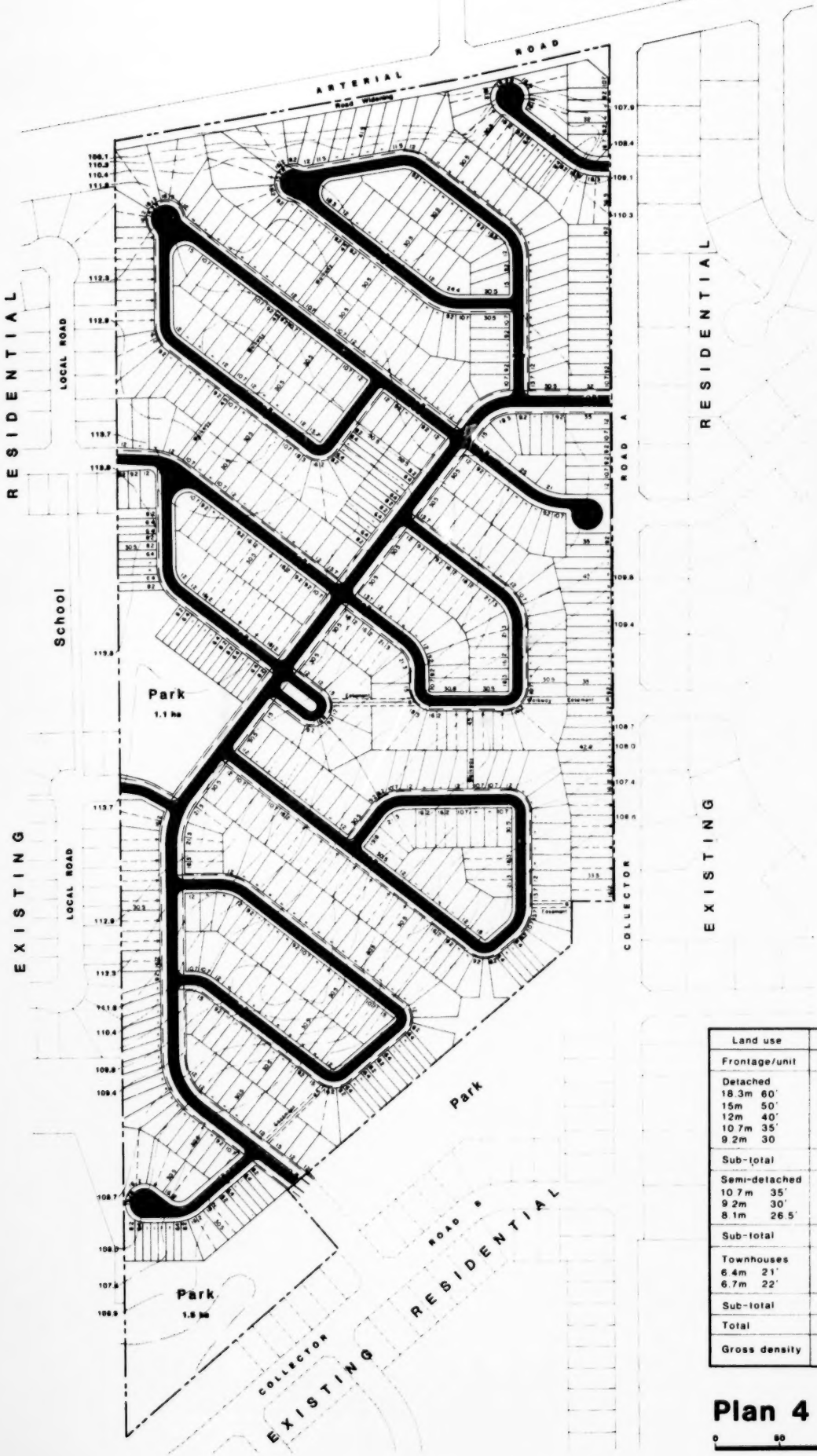
- Road costs are lower than Plan 2 because of the redesign of the street layout.

Phasing

- A different approach from that used in Plans 1 and 2 is offered as an alternative.
- The first phase is adjacent to the arterial road, surrounded on two sides by existing residential development and nearer the school.
- A major sanitary sewer is available on the eastern boundary of the first phase.
- The drainage requirements for a sanitary sewer largely determine the size and shape of the phases.
- Phases 1 and 2 are related to two drainage areas — one to the collector and the other to the sanitary sewer crossing the site. The southernmost boundary is at the limit of the collection point for drainage into the cross-site sewer.
- Phase 3 is dependent on a new length of sewer along the major internal street.
- Phase 4 is infilling.
- Each phase, which ranges in area from approximately 6 to 8 hectares (15 to 20 acres), has at least two permanent access points.

Development Phasing





Land use	Plan 4	
Frontage/unit	# units	%
Detached 18.3m 60' 15m 50' 12m 40' 10.7m 35' 9.2m 30	 187 82 144	 28.0 12.3 21.7
Sub-total	413	62.0
Semi-detached 10.7m 35' 9.2m 30' 8.1m 26.5'	 168	 25.5
Sub-total	168	25.5
Townhouses 6.4m 21' 6.7m 22'	83	12.5
Sub-total	83	12.5
Total	664	100
Gross density	8.4 u/ac. 20.8 u/ha.	

Plan 4

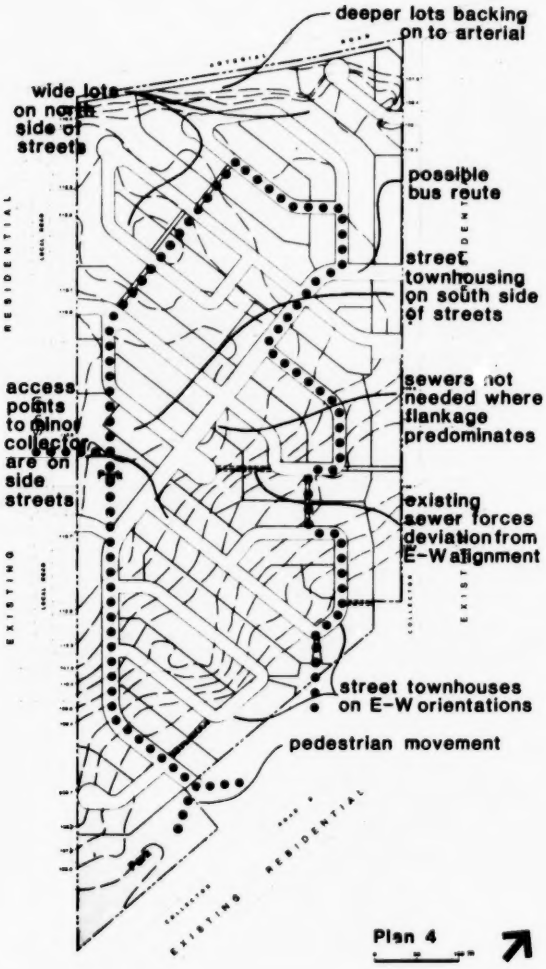
0 50 100 m

Plan 4

Design Objective

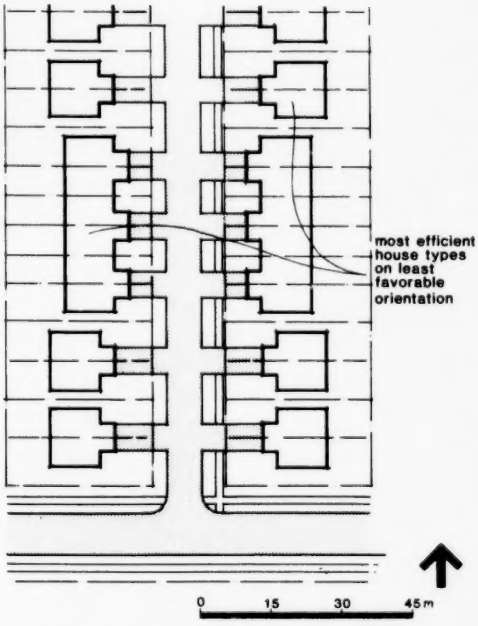
To design a subdivision using the Ministry of Housing's "Urban Development Standards" to conserve space heating energy.

Design Characteristics


deeper lots backing on to arterial
wide lots on north side of streets
possible bus route
street townhousing on south side of streets
sewers not needed where flankage predominates
access points to minor collector are on side streets
existing sewer forces deviation from E-W alignment
street townhouses on E-W orientations
pedestrian movement
RESIDENTIAL
EXISTING
Plan 4

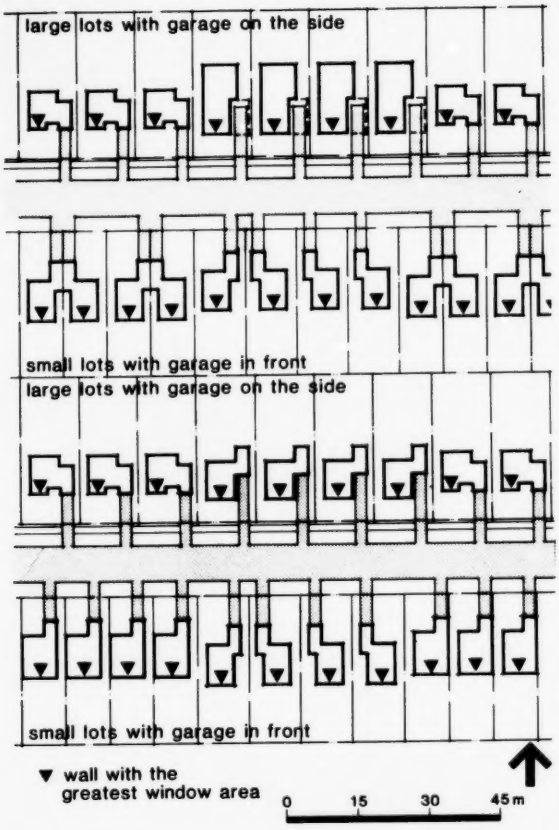
- The main objective of the design is to maximize the north-south orientation of the lots and the east-west orientation of the streets.
- The minor collector provides a route for public transit.
- Cross streets are avoided wherever possible.
- There are few driveways onto the minor collector. The majority of driveways are on local streets.

- Street townhouses and semi-detached houses are less expensive to heat than single family detached houses because they have fewer outside walls. Therefore, it is more important that the single family houses be oriented to the south to take advantage of heat from the sun than the semi-detached or townhouses. This is a necessary trade-off.



Semi-detached and townhouse units are better suited for less than ideal orientations.

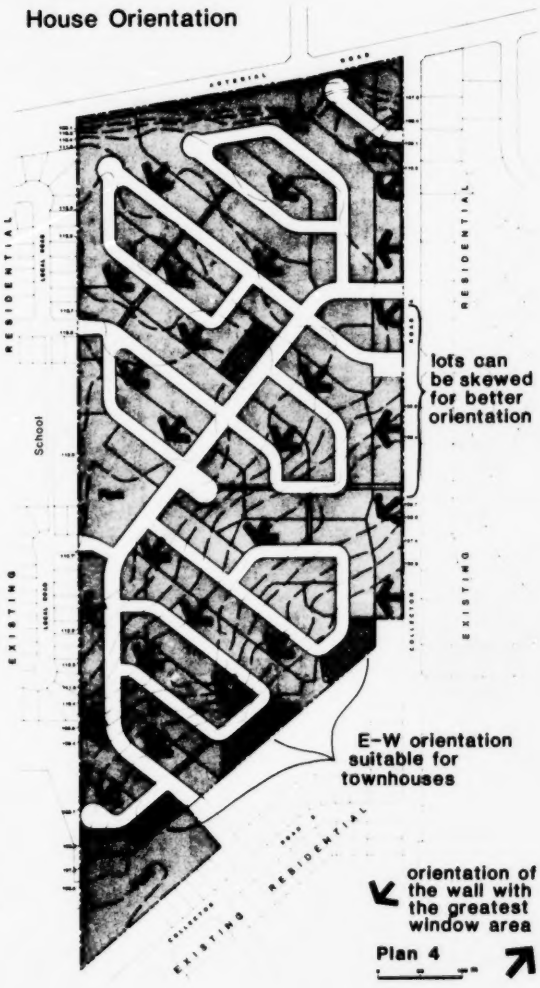
- Single family detached housing, with garages to the side of the house to avoid shading, are located on the north side of the street.
- Semi-detached units and street townhouses, with garages in front of the units to allow a better solar exposure to the major window area, are located on the south side of the street.
- The straight, long roads required to obtain maximum solar exposure and the need to limit building set-back in order to avoid excessive shading of one building by another may cause some streetscape problems. Landscaping and building design co-ordination will overcome any potential problems.


large lots with garage on the side
small lots with garage in front
large lots with garage on the side
small lots with garage in front
▼ wall with the greatest window area
0
15
30
45m

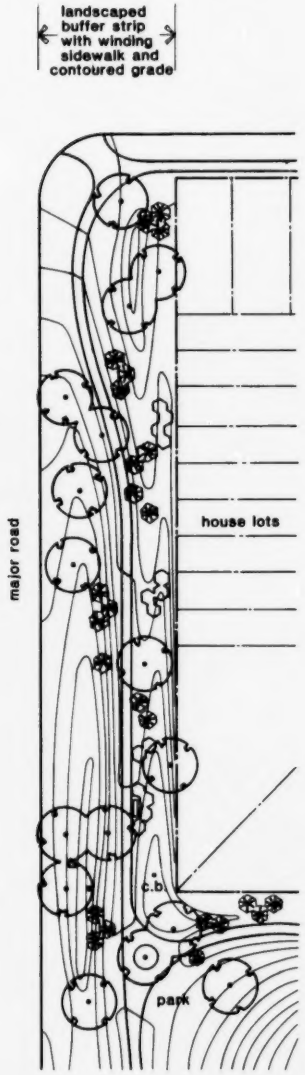
Careful siting of houses on the most appropriate lots will avoid shading during winter months.

- Landscaping should provide shade from the sun in summer and protection from the wind in winter.

House Orientation



- Certain situations demand particular landscaping solutions. For example, there is a need for a buffer between rear yards and major roads in those areas where reverse frontage is used.



Subdivision Analysis

	Plan 4
Gross area	31.8ha. 78.7ac.
Road length 21.5m 70' R.O.W. 20m 66' 17m 56' 15m 50'	 320m 1050' 822.9 2700' 3115m 10222'
Total road length	4265.7m 13995'
Area of roads	7.0ha. 17.5ac.
Road area as % of total area	22.23
Saleable frontage	6675m 21900'
Road length/ Saleable frontage ratio	1:1.56

- The density of 21.0 units per hectare (8.4 units per acre) is a slight drop from Plan 3. This is largely the result of not being able to use narrow lots on the north side of an east-west street.
  Narrow lots generally mean less window area and, in those cases where a garage is also included in the frontage, there is very little wall available for windows. Consequently, density is lost by substituting wider lots in this situation.

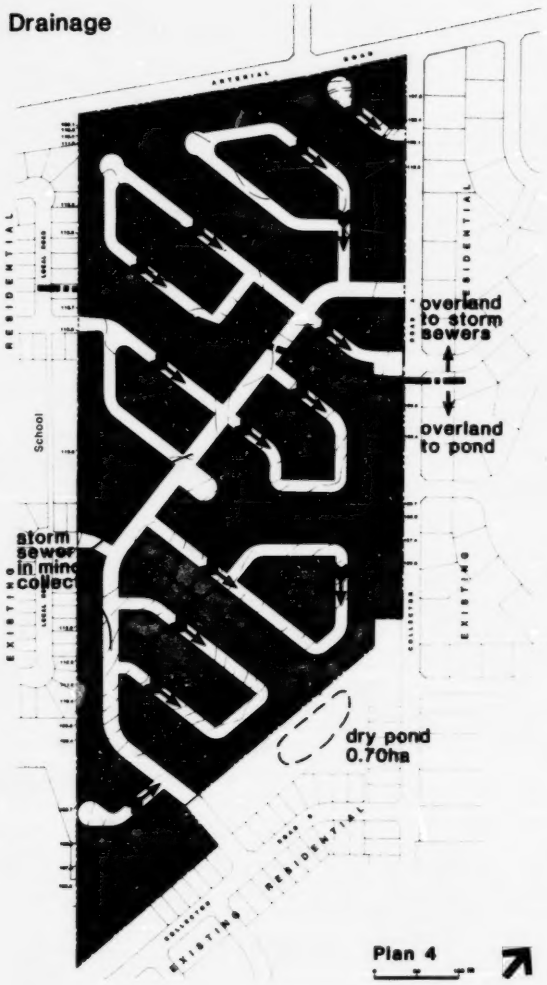
Underground Services and Road Construction

	Plan 4
Sanitary sewers	$575,990.00
Storm sewers	$96,690.00
Watermain	$397,958.00
Roads	$1,073,066.61
Provisional items	$13,868.23
Contingency	$64,727.18
Sub-total	$2,222,299.92
Engineering 12% of sub-total	$266,675.99
Total	$2,488,975.91

# units	664
Cost/unit	$3,748.48

- There does not seem to be an extra cost for underground services and road construction in a subdivision designed to maximize solar energy.
- This plan uses overland run-off to the storm sewer system and a "dry" pond in the park.

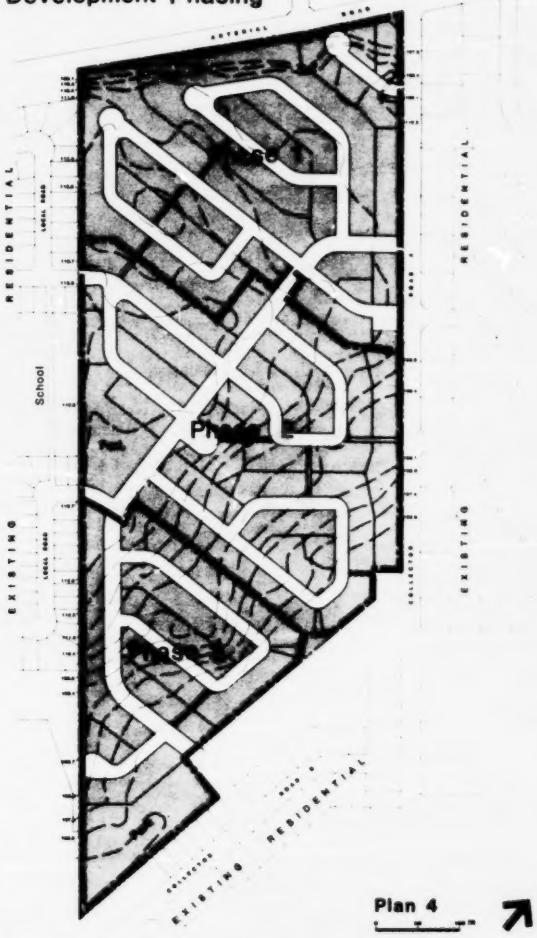
Drainage



Phasing

- A phasing strategy is adopted that is similar to Plan 3 except that there are three instead of four phases.
- The change in road orientation from that of Plan 3 has allowed a better relationship between the size of the phases and the drainage pattern.

Development Phasing



3. Conclusions

- These four alternative plans show a range of development possibilities in a low density subdivision in terms of layout, number of units, costs of underground services and road construction, and use of solar energy.
- Plans 1, 2 and 3 contain virtually the same conventional mix of detached (60%), semi-detached (30%), and street townhouses (10%). The densities differ substantially, especially in relation to Plan 1, because of the use of "Urban Development Standards". With the continuing increase in the market price of housing, the increase of over 50 per cent in the number of housing units could mean an opportunity to keep house prices at a more reasonable level.
- Road lengths do not show much variation. Road acreage for Plan 1 is higher because of the use of only one traditional road right-of-way.
- Saleable frontage increases with the use of "Urban Development Standards".
- Costs of underground services and road construction vary noticeably between Plans 1, 2 and 3.
- The most efficient subdivision in terms of per dwelling unit cost is Plan 3 which is designed using the Ministry of Housing's "Urban Development Standards".

Land use	Plan 1		Plan 2		Plan 3		Plan 4	
Frontage/unit	# units	%	# units	%	# units	%	# units	%
Detached								
18.3m 60'	30	6.6						
15m 50'	236	52.4	34	5.3				
12m 40'			125	19.5	123	18.4	187	28.0
10.7m 35'			116	18.0	161	24.0	82	12.3
9.2m 30'			103	16.1	124	18.5	144	21.7
Sub-total	269	59.0	378	58.9	408	60.9	413	62.0
Semi-detached								
10.7m 35'	116	25.7	10	1.5				
9.2m 30'	18	4.3	72	11.4				
8.1m 26.5'			106	16.6	194	29.0	168	25.5
Sub-total	134	30.0	188	29.5	194	29.0	168	25.5
Townhouses								
6.4m 21'					70	10.1	83	12.5
6.7m 22'	51	11.0	74	11.6				
Sub-total	51	11.0	74	11.6	70	10.1	83	12.5
Total	454	100	640	100	672	100	664	100
Gross density	5.7 u/ac. 14.2 u/ha.		8.1 u/ac. 20.1 u/ha.		8.5 u/ac. 21.1 u/ha.		8.4 u/ac. 20.8 u/ha.	

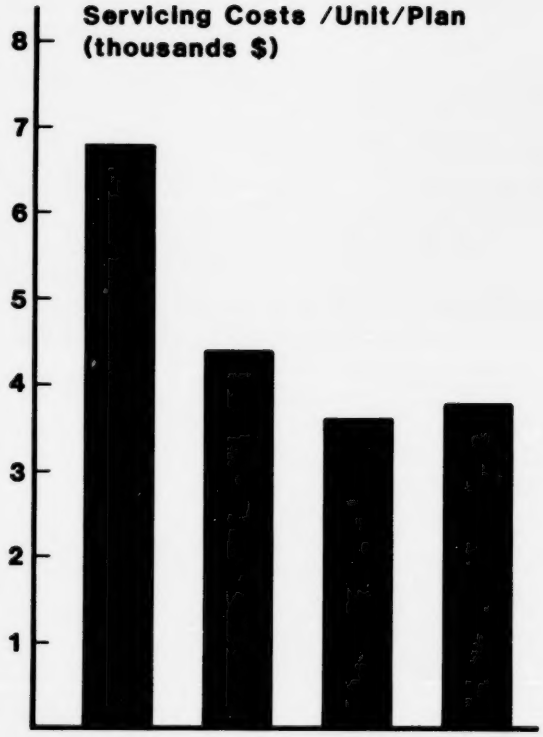
	Plan 1	Plan 2	Plan 3	Plan 4
Gross area	31.8ha. 78.7ac.	31.8ha. 78.7ac.	31.8ha. 78.7ac.	31.8ha. 78.7ac.
Road length 21.5m 70' R.O.W. 20m 66' 17m 56' 15m 50'	 320m 1050' 3901m 12800'	 320m 1050' 1714.5m 5625' 495m 1625' 1722m 5650'	 320m 1050' 899m 2950' 2819m 9250'	 320m 1050' 822.9m 2700' 3115m 10222'
Total road length	4221m 13850'	4259.5m 13975'	4046m 13275'	4265.7m 13995'
Area of roads	8.5ha. 21.10ac.	7.6ha. 18.81ac.	6.7ha. 16.8ac.	7.0ha. 17.5ac.
Road area as % of total area	26.81	23.90	21.34	22.23
Saleable frontage	5934m 19470'	6233m 20450'	6530m 21425'	6675m 21900'
Road length/ Saleable frontage ratio	1:1.4	1:1.46	1:1.61	1:1.56

- However, the energy-efficient subdivision (Plan 4), also designed using these standards, had only a modest increase in the per dwelling unit cost. The traditional plan of subdivision (Plan 1) is the most costly to build and is the least energy-efficient.

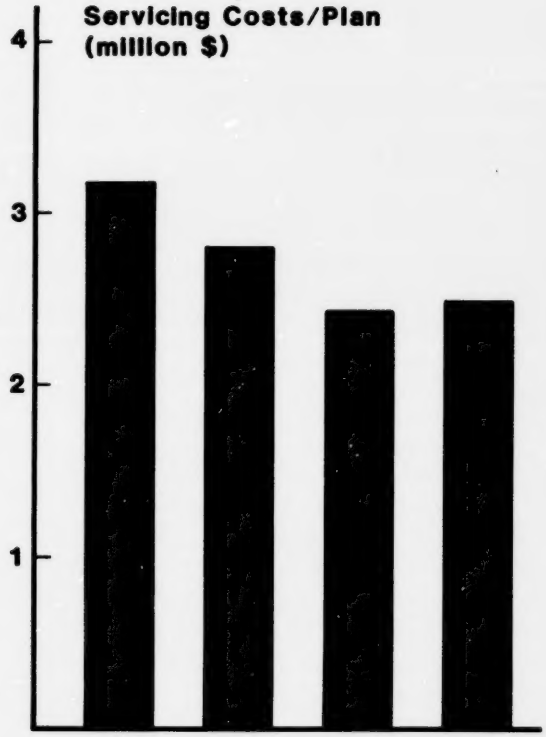
- The subdivisions discussed in this report are only a small selection of the number of alternatives available to the site designer. The important principle is that each option should be carefully considered from the point of view of economy, aesthetics, and the impacts of environmental factors and energy conservation requirements.

	Plan 1	Plan 2	Plan 3	Plan 4
Sanitary sewers	$474,850.00	$537,600.00	$577,980.00	$575,990.00
Storm sewers	$541,745.00	$290,115.00	$96,660.00	$96,690.00
Watermain	$375,500.00	$389,590.00	$397,925.00	$397,958.00
Roads	$1,253,683.45	$1,135,432.00	$1,043,984.00	$1,073,066.61
Provisional items	$16,875.03	$15,122.42	$13,705.25	$13,868.23
Contingency	$79,881.41	$71,035.00	$63,907.63	$64,727.18
Sub-total	$2,742,595.89	$2,438,896.07	$2,194,162.00	$2,222,299.92
Engineering 12% of sub-total	$329,111.38	$292,667.53	$263,299.00	$266,675.99
Total	$3,071,706.27	$2,731,563.60	$2,457,461.48	$2,488,975.91

#.units	454	640	672	664
Cost/unit	$6,766.80	$4,268.06	$3,656.93	$3,748.48



Servicing costs per unit are greatly reduced by the increase in yield afforded by the standards used.



The overall cost can be substantially affected by the choice of standards.